VIRGINIA MINERALS

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT
Richmond, Virginia

Published by the DIVISION OF MINERAL RESOURCES, James L. Calver, Commissioner
Box 3667, University Station, Charlottesville, Virginia

Vol. 11 | MAY, 1965 | No. 2

JOHN W. FLANNAGAN DAM

The Prepaid Dam

Ernest H. Ern[1]

A unique situation exists when a project obtains its economic objective prior to completion. In March 1963, heavy rains in the upper Big Sandy watershed impounded over 12,000 acre feet of flood storage in the Flannagan reservoir (Figure 1) even though the outlet works were not subject to closure at that time. Studies by the U. S. Army Corps of Engineers estimated this storage prevented over $15,000,000 in flood damage along the Big Sandy River. Since one of the major justifications for constructing this dam was to prevent flood damage to an amount at least equalizing project costs and since only $9,500,000 had been expended at the time of the March 1963 floods, the investment was indeed repaid in advance.

The John W. Flannagan Dam (Figure 2), scheduled for completion early in 1966, is located in Dickenson County, Virginia on a horseshoe bend in the Pound River, 1.8 miles upstream from its confluence with Russell Fork of the Big Sandy River, approximately 5 miles northwest of the town of Haysi via U. S. Highway 83 and State Road 614. The Pound River watershed is situated in the southern portion of the Big Sandy River basin which is a tributary to the Ohio River near Ashland, Kentucky. The dam forms an integral part of the Big Sandy flood control system and will be used to help eliminate river pollution and provide a recreational facility for southwestern Virginia. Water in the reservoir will be backed up for 15 miles in the Pound River and nearby Cranes Nest River.

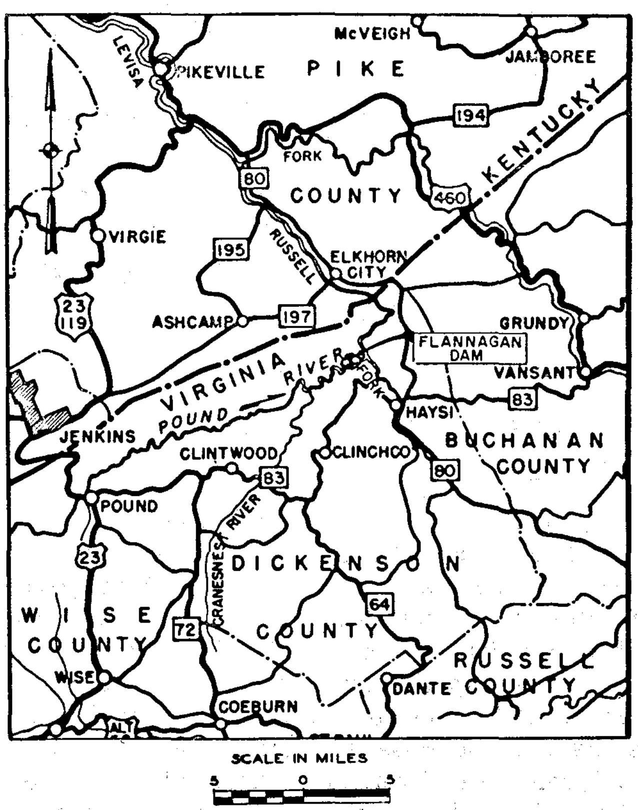


Figure 1. Location map showing John W. Flannagan Dam and surrounding area.

[1] Department of Geology, University of Virginia, Charlottesville, Virginia.

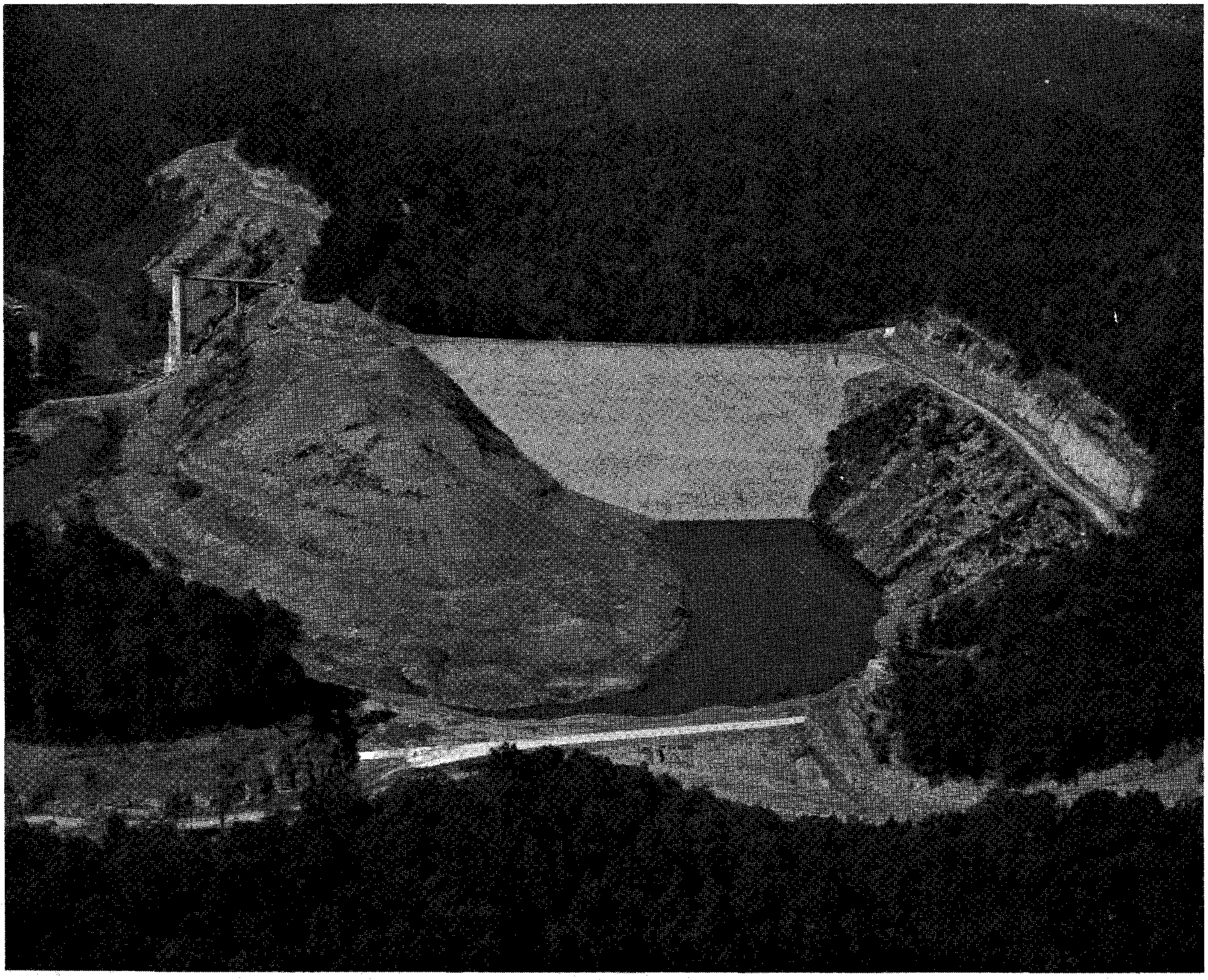


Figure 2. Aerial view of the rolled-rock and earth-filled John W. Flannagan Dam. The dam is 260 feet high and 916 feet long at the crest. Auxiliary cofferdam to effect diversion through tunnel during final construction of intake tower is visible in upper left. Spillway site is in low saddle on right bank 1800 feet upstream from dam (lower portion of photo). (Photo taken July 1963).

Topographically, the area is situated in the Kanawha section of the Appalachian Plateau (Figure 3). The terrane is maturely dissected with an average relief of 550 feet. The channel of the Pound River is sinuous and bounded by steep-sided, narrow ridges. The elevation of the stream channel at the dam axis is 1210 feet above sea level. The bedrock consists of flat-lying sedimentary rocks belonging to the Pottsville Group of Early Pennsylvanian age. Three formations are present in the area; they are, in ascending order, the Norton Formation, the Gladeville sandstone, and the Wise Formation. The foundation, abutments, and diversion tunnel are in the Norton Formation. At the site, this formation consists of massive, bluff-forming, medium- to coarse-grained, well-cemented sandstone beds with shale, silstone, fine-grained sandstone, and coal layers. The shale beds are sandy or silty and moderately fissile with minor interbeds of clay-shale and micaceous laminations. The shales in the more fissile zones exhibit different rates of slaking and have diverse degrees of cementation and stability. There are numerous coal seams ranging in thickness from less than an inch to more than 30 inches. The argillaceous Gladeville sandstone, which crops out near the top of the right abutment on the northeast end at the dam axis, and the Wise Formation cap the hills in the area. Both units were utilized to some extent for rock borrow. Overburden rarely exceeds 5 feet in thickness and consists of residual sandy and silty clays.

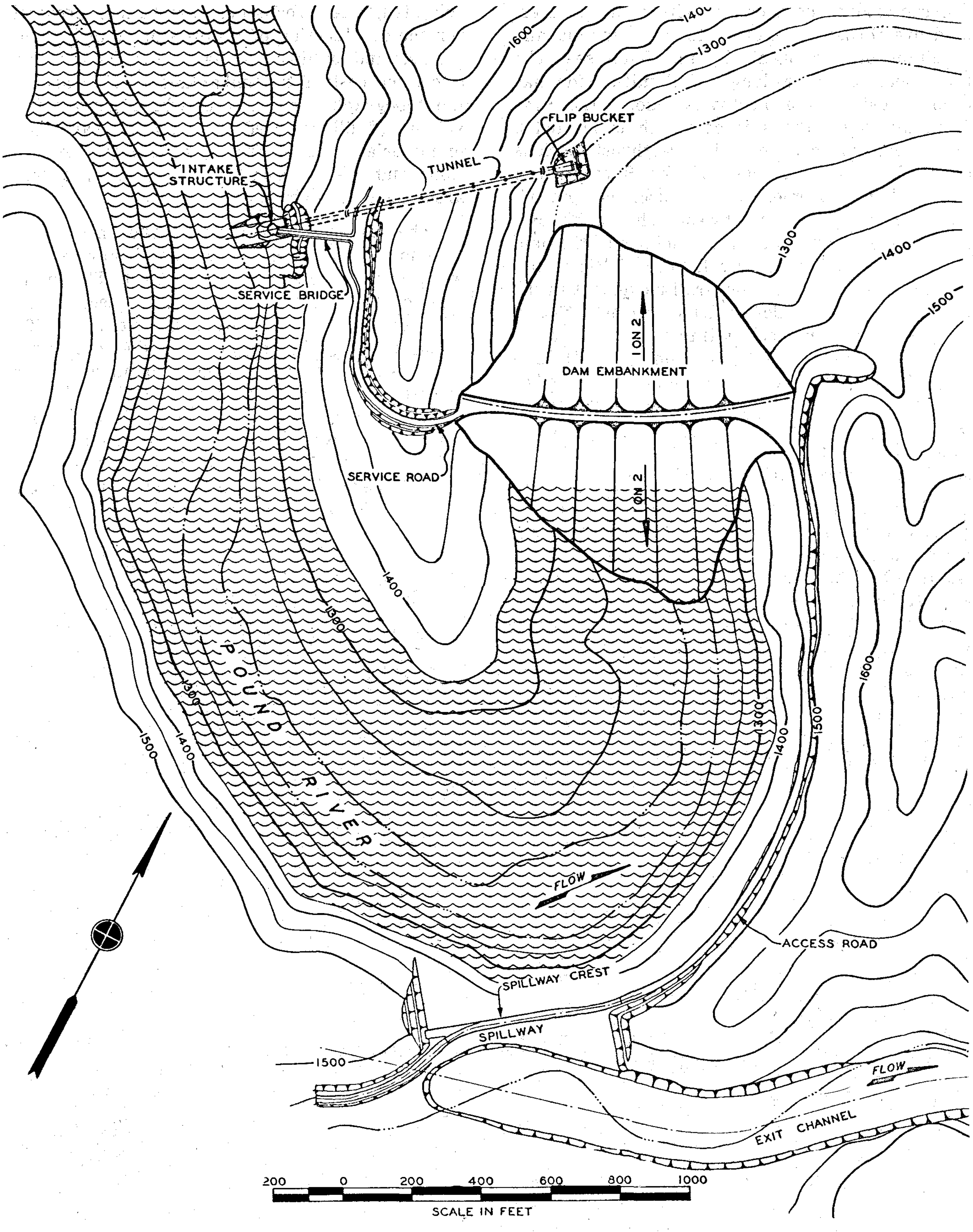
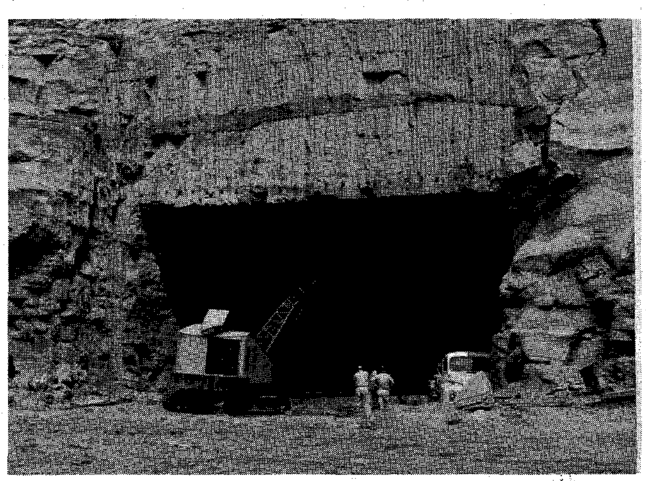


Figure 3. General plan map of the John W. Flannagan Dam and reservoir.

Structurally, the area lies within the Cumberland overthrust block of southwest Virginia and adjoining parts of Kentucky and Tennessee. The fault block, 125 miles long and 25 miles wide, has been thrust to the northwest along the Pine Mountain fault, the axis of which is located 3 miles north of the dam. The overthrust block is bounded on the northeast by the Russell Fork fault, where movement of the block is approximately 2 miles to the northwest. The steeply dipping Russell Fork fault in the vicinity of the dam is coincident with the Russell Fork of Big Sandy River. Impressive as the overall movement in the block has been, the deformation has not affected the stability of the rock within the project area. The axis of the dam is situated on the north limb of the broad Middlesboro syncline that strikes to the northeast through the area. Two major sets and five minor sets of joints occur in the foundation rock. The joints, on 15 to 20 foot spacings, are weathered, but close with depth.

The dam was originally planned as a concrete-gravity structure based on preliminary field explorations in 1940 by the U. S. Army Corps of Engineers. This plan was abandoned because of an insufficient quantity of available fill material. Additional detailed investigations and borings were made during 1957-1958 to locate sufficient earth that could be utilized for a rock- and earth-filled dam. This new plan permitted construction of a less expensive dam. Many factors regulate the overall economics of such a construction project. Besides the cost of the required embankment materials, land must be purchased, roads and bridges relocated, access roads made, and funds provided for the construction of a diversion tunnel, outlet works, and spillway. The major factors that affect the cost of the embankment materials are the topography at the site, which governs the volume of fill required; the quantity and type of material obtained from the necessary excavation; and the accessibility of necessary borrow areas near the dam site.

The sequence of construction began with excavation for the diversion tunnel (Figure 4) and work on the access road during 1960. The tunnel was completed by late spring of the second year with diversion being effected in September 1961. Prior to laying the embankment, the core trench and abutments were stripped to sound rock (Figure 5) and suitably curtain grouted to prevent seepage under and around the dam. The embankment section was topped out in December 1962. To allow for additional storage for water-quality control, the spillway, which is still under construction, is designed to include a gated weir structure.



U. S. Army photograph

Figure 4. Inlet to the diversion tunnel. The tunnel is 16 feet in diameter, 970 feet long, and has a maximum flood discharge of 10,000 cubic feet per second.

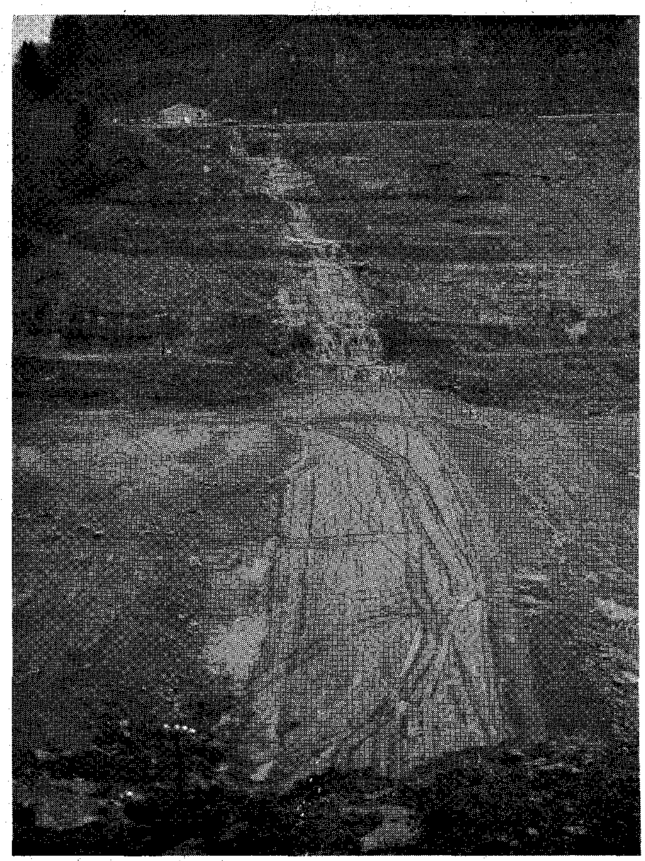


Figure 5. View across axis of dam showing exposed core trench on right abutment. Embankment construction has been initiated with the placing of the central impervious core.

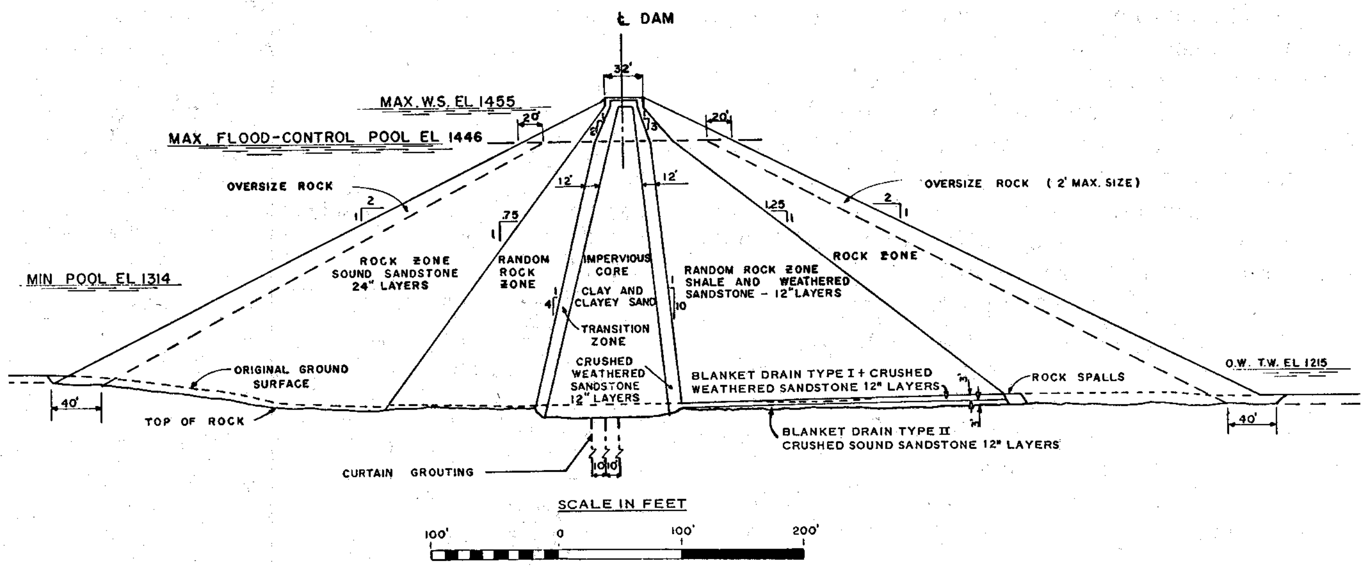
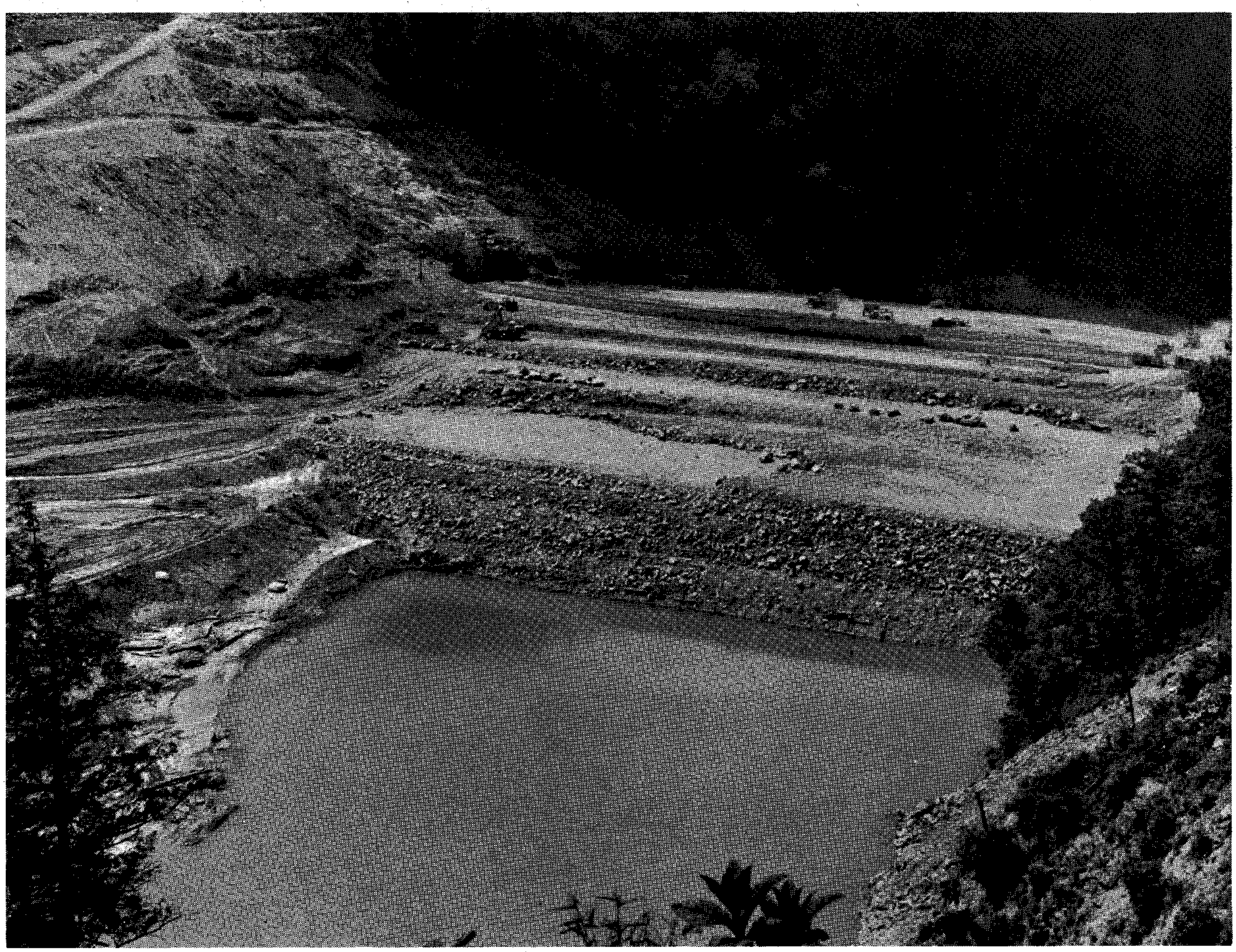


Figure 6. Embankment section showing composition of various zones. More than 2 million cubic yards of rock-fill and a quarter of a million cubic yards of impervious material were used in constructing the embankment.



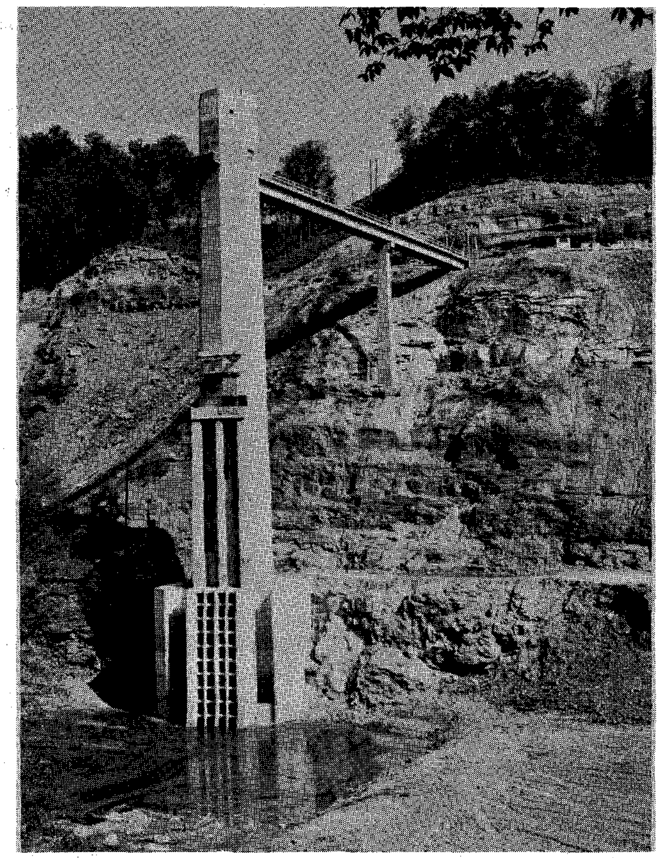
U. S. Army photograph

Figure 7. General view of dam while under construction (May 1962).

The embankment section consists of a central impervious core of clay and clayey sand bounded by transition zones of graded crushed sandstone (Figure 6). The random zones of the dam are composed of shale and weathered sandstone, and the rock zones of sound sandstone. A drainage blanket is provided for the downstream portion of the dam. The required embankment material was obtained from borrow areas within an average haul distance of 0.5 mile from the damsite. The rock from the spillway excavation was unsuitable for the dam, but was utilized for haul roads and in miscellaneous fills. The core was laid in 6- and 12-inch compacted lifts, and the random and sound-rock zones were placed in 12- and 24-inch rolled layers. Both the transition and filter-blanket materials, which were derived from crushed sandstone, were placed in 12-inch lifts (Figure 7).

The dam is 260 feet high and 916 feet long at the crest, with a maximum base width of 1030 feet and a top width of 32 feet. The embankment consists of more than 2 million cubic yards of rockfill and a quarter of a million cubic yards of impervious material.

Discharge from the reservoir is by a diversion tunnel through the left abutment which is aligned approximately parallel to the axis of the dam (Figure 8). Flow control is effected through two



U. S. Army photograph

Figure 9. Intake structure for diversion tunnel. The tower is 204 feet high and located upstream from horseshoe bend in river.

U. S. Army photograph

Figure 8. View from top of dam of water discharge through diversion tunnel during flood of March 1963.

conduits controlled with 4- by 8.5-foot hydraulic slide gates installed in tandem in the 204-foot-high intake tower (Figure 9). The concrete-lined tunnel is 970 feet long, on a 2 percent grade, and emerges 800 feet downstream from the axis of the dam. The tunnel has a diameter of 16 feet and a maximum flood discharge of 10,000 cubic feet per second.

Overflow from the reservoir will be by a 260-foot-high spillway located on a narrow saddle on the right bank of the stream 1800 feet upstream from the dam. Topped water will flow through Cain Branch that has been widened and deepened, and it will rejoin the Pound River approximately 7000 feet below the dam. The spillway has a gross crestal length of 292 feet, is controlled by six 42- by 36-foot tainter gates, and has a design discharge of 244,000 cubic feet per second.

The John W. Flannagan Dam will be used to control drainage over an area greater than 222 square miles. The reservoir will contain a permanent pool of 310 acres, a water-quality-control pool of 927 acres, and a flood-control pool of about 2098 acres. A certain amount of water will be impounded in the reservoir during the spring rain and thaw period to prevent flooding downstream. During the dry summer months when the stream runoff is low, water will be released to flush streams of accumulated sewage and debris. The reservoir pool will build back up during the winter and spring as is necessary for the project to assume its role as an anti-flood measure. The reservoir will also serve as a much desired fishing and boating facility in the southwestern Virginia area.

* * * * * * *

OIL AND GAS DEVELOPMENT IN VIRGINIA DURING 1964

David M. Young[1]

Development in Virginia during 1964 was highlighted by the completion of seven successful gas wells in northwestern Tazewell County. These were drilled to an average total depth of about 5300 feet through the Berea sandstone with a combined total openflow after fracture of 41,223 Mcf.

[1] Chief Geologist, Clinchfield Coal Company, Division of The Pittston Company, Dante, Virginia. Oliver W. Lineberg, State Oil and Gas Inspector, furnished production information for Buchanan, Lee and Tazewell counties.

Late in 1964, a deep test was started in the Rose Hill oil field of Lee County by the Shell Oil Company. This was plugged and abandoned early in 1965 at a total depth of 8020 feet. Also, in Lee County, an offset was drilled to the discovery well near Ben Hur that secured small Trenton oil production in 1963. This well has been shut down at 2000 feet. Oil production from the Rose Hill field and from the Ben Hur well amounted to 5828 barrels in 1964.

There was no drilling activity in Buchanan and Dickenson counties. Buchanan County gas production totaled 1,285,626 Mcf and that of Dickenson County 584,031 Mcf. Total gas production for the State was 1,881,771 Mcf, of which 12,124 Mcf were produced in Tazewell County, where deliveries did not start until late in the year.

There was no development or exploratory drilling in Buchanan County during 1964. Gas production delivered to lines of the Hope Natural Gas Company and United Fuel Gas Company totaled 1,285,626 Mcf.

No new drilling was undertaken in Dickenson County in 1964. The Clinchfield Coal Company delivered 584,031 Mcf of gas to the Kentucky West Virginia Gas Company.

On December 7, 1964, the Shell Oil Company started drilling their No. 1 L. S. Bales, located 6077 feet west of long 83°20′ W. and 17,911 feet south of lat 36°40′ N. The location is about 1 mile east of a prominent group of fensters in the Cumberland overthrust block where erosion has cut through the Copper Ridge dolomite on the upthrown side of the block to expose Silurian and Ordovician rocks beneath the sole of the overthrust. It is in and around these fenster areas that most of the oil production in the Rose Hill field has been obtained. Drilling of the Bales well was completed at a total depth of 8020 feet on January 27, 1965. The well was plugged and abandoned shortly thereafter. According to the record filed with the Virginia Division of Mineral Resources at Charlottesville, there were no significant oil or gas shows. Also, according to this record, the well terminated in a cherty dolomite without penetrating Precambrian basement rocks. A set of 726 samples representing the interval from 560 to 8020 feet is on open file under number W-1273 at the Division of Mineral Resources.

In June 1961, the first successful gas well was completed in Tazewell County, Virginia, by the United Fuel Gas Company to a depth of 5145 feet

Table 1.—Virginia development—1964 (Including January 1965)

Company	Farm	Well No.	Total Depth	Initial Openflow (Mcf)	Final Openflow (Mcf)	Status
Tazewell County						
Consolidation Coal Company	Pocahontas Fuel Company	1	5097	933	5700	Gas Well
Do.	do.	2	5040	1130	3000	Do.
Do.	do.	3	5128	696	2000	Do.
Do.	do.	4	5511	150	4000	Do.
Do.	do.	5	5350	64	980	Do.
Do.	do.	6	5538	2000	12,840	Do.
Do.	do.	7	5000+	50	500	Do.
United Fuel Gas Company	New River and Pocahontas Consolidated Coal Company	32 (9342)	5604	4599	12,703	Do.
Do.	do.	33 (9355)	5025	1699	4108	Do.
Lee County						
Shell Oil Company	L. S. Bales	1	8020	No measurable shows		P P & A
J. W. Miloncus	Wynn	1	2000	——	——	Shut Down

through the Berea sandstone. The well made 3846 Mcf of gas and was not fractured. The 48-hour rock pressure was 895 psi.

In March 1964, the Consolidation Coal Company drilled a location about 2 miles south of the discovery well to a depth of 5097 feet through the Berea with a natural openflow of 933 Mcf. After fracture, the well made 5700 Mcf. During the year, the same operator completed 5 additional wells to depths ranging from 5000 to 5500 feet and with a combined total openflow after fracture of 22,820 Mcf. In December 1964, the United Fuel Gas Company completed their second well in the same area with a final openflow after fracture of 12,703 Mcf and 48-hour rock pressure of 925 psi. Early in 1965, the Consolidation Coal Company completed their seventh well with a final openflow of 500 Mcf, and United Fuel Gas Company completed their third well with an openflow after fracture of 4108 Mcf. Thus, a total of nine wells were completed in 1964 and early 1965 with a combined openflow after fracture of 45,831 Mcf. Total developed openflow from 10 wells, including the discovery well drilled in 1961, amounts to 49,677 Mcf.

Delivery of this gas started late in 1964 with 12,124 Mcf metered during the last few days of the year. The gas is delivered to the 20-inch line of the Atlantic Seaboard Corporation a few miles north of the producing area.

* * * * *

NEW COAL MINE PLANNED FOR BUCHANAN COUNTY

Island Creek Coal Company's Board of Directors on March 9, 1965, approved appropriations approximating 15 million dollars for the development of a second mine in Buchanan County, Virginia, which will produce at full capacity 2 million tons annually of the finest quality low volatile metallurgical coal. James L. Hamilton, Chairman of the Board, stated that work on the new mine is scheduled to commence this spring, to start producing late in 1967, and to achieve capacity in 1968. It is being engineered for a forty-year life.

"The new mine," Mr. Hamilton said, "will be opened in the company's 500 million-ton reserve area of Pocahontas No. 3 seam, low ash, low volatile metallurgical coal in Virginia, and will largely duplicate the Beatrice mine now in production. The Beatrice Pocahontas mine, near Grundy, Virginia, jointly owned by Republic Steel Corporation and Island Creek, is currently making shipments not only for Republic's needs, but also to consumers both in the United States and abroad."

Mr. Hamilton also stated that plans are being engineered to provide storage and rapid-loading facilities for high-volume unit trains necessary to provide low-cost shipments to U. S. consumers; and also to facilitate loading the large ocean-going vessels now engaged in exporting American coals. Currently, some shipments are being made in vessels with capacities of 60,000 gross tons; however, vessels to transport 85,000 gross tons are now under construction both in Europe and Japan.

Mr. Hamilton continued that "because of the increased demand created through the excellent results and lower hot metal costs obtained from the use of our Beatrice coals by the American and foreign steel industries, we feel confident that the output from this second mine will meet ready acceptance in these same markets." The new mine will be served by the Norfolk and Western Railway Company.

* * * * *

News Notes

The Kyanite Mining Corporation added to their operations on March 5, 1965, a new processing, bagging, and storage plant located 2 miles north of Dillwyn, Buckingham County, on the Chesapeake and Ohio Railway. The company, whose main offices are located at Dillwyn, will continue to operate processing plants at the Willis Mountain mine, Buckingham County and the Baker Mountain mine, Prince Edward County and a grinding and bagging plant near Pamplin, Prince Edward County. When the new plant is fully integrated into the company's manufacturing system, all calcined-base products will be manufactured and handled by the installation. The addition of this plant will bring about centralization of calcined products, increase storage capacity, and facilitate faster shipment of the kyanite products.

The Foote Mineral Company commenced production of crushed magnetite ore during January, 1965, at a new mill adjacent to the company's underground limestone mine at Kimballton, Giles County. The magnetite ore from New York and Canada is crushed and marketed under the trade name, "Magna-flow," for coal preparation.

New Publication

Information Circular 9. GEOLOGIC LITERATURE OF THE COASTAL PLAIN OF VIRGINIA, 1783-1962 by James L. Ruhle. 95 p. Price: $0.50

A total of 975 references have been compiled for the period 1783-1962. In addition to references concerning the geology of the Virginia Coastal Plain, such related subjects as soils, oceanography, geodetic surveys, floods, and stream-flow data have been included. Most of the entries are from published sources, but some unpublished material, such as master's or doctoral theses, have been listed. Entries are listed alphabetically by author.

* * * * *

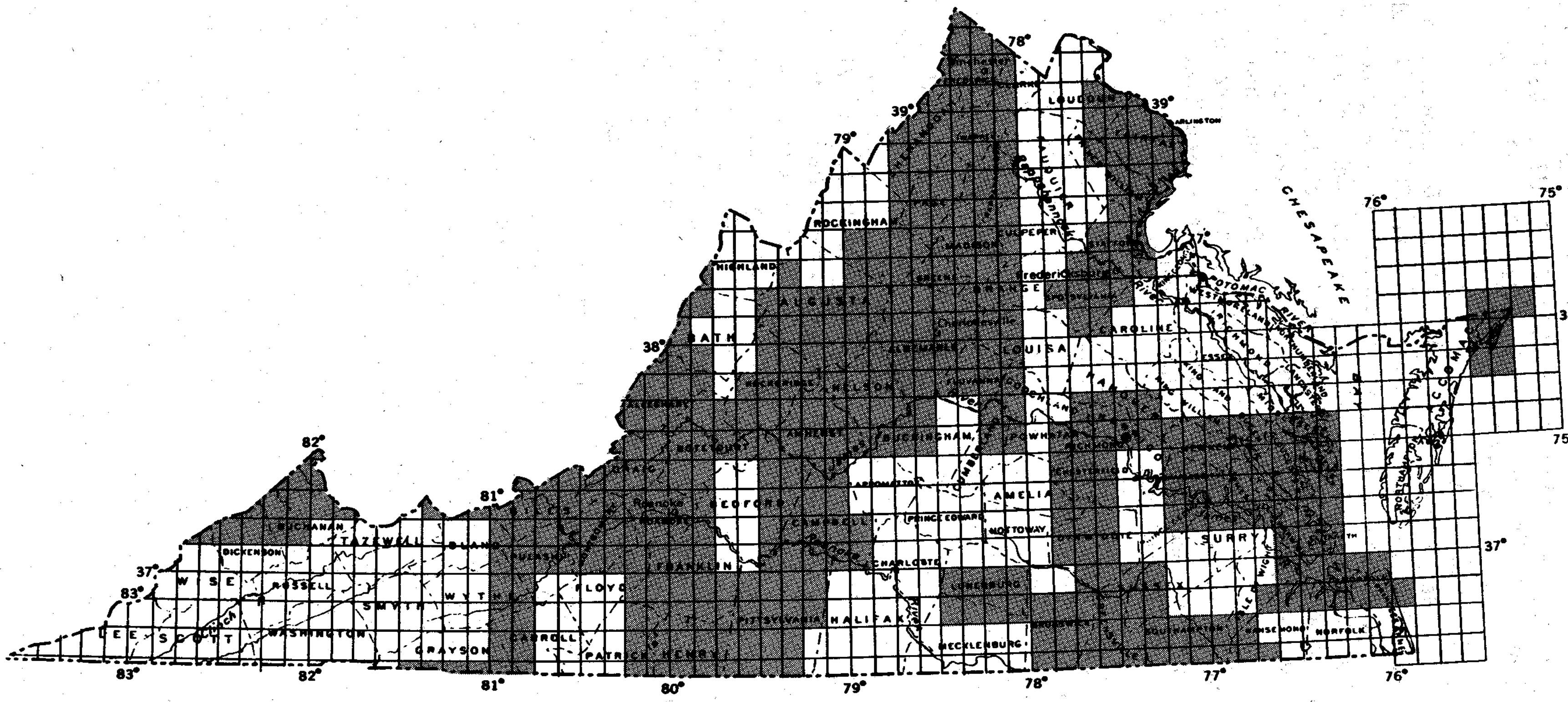
Additions to Staff

Mr. James F. Conley joined the Division on April 1, 1965, and will direct stratigraphic studies including the determination and distribution of the various rock units in Virginia. He received a B. A. degree in geology from Berea College in 1954 and a M. S. degree in geology from Ohio State University in 1956. From July 1956 to March 1965, Mr. Conley was employed by the North Carolina Division of Mineral Resources; he had been geologist in charge of the Western District Office at Asheville, North Carolina since its establishment in 1961. He is married and has three sons.

Mr. Harry W. Webb was employed by the Division on April 16, 1965, and will direct the transfer of existing geologic map data to new 7.5 minute series topographic maps as they become available. His education consists of a B. S. degree in geology from Virginia Polytechnic Institute in 1951 and an M. S. geology degree from Louisiana State University in 1955. Working experience comprises 2 years as photo interpreter, U. S. Air Force; 2 years as subsurface geologist, Carter Oil Company; 6 years as stratigrapher, Shell Oil Company; 1 year as terrain analysis specialist, U. S. Department of Defense. Areas employed in include Japan, Montana, North Dakota, Louisiana, Mississippi, and Virginia.

* * * * *

AERIAL PHOTOGRAPHY

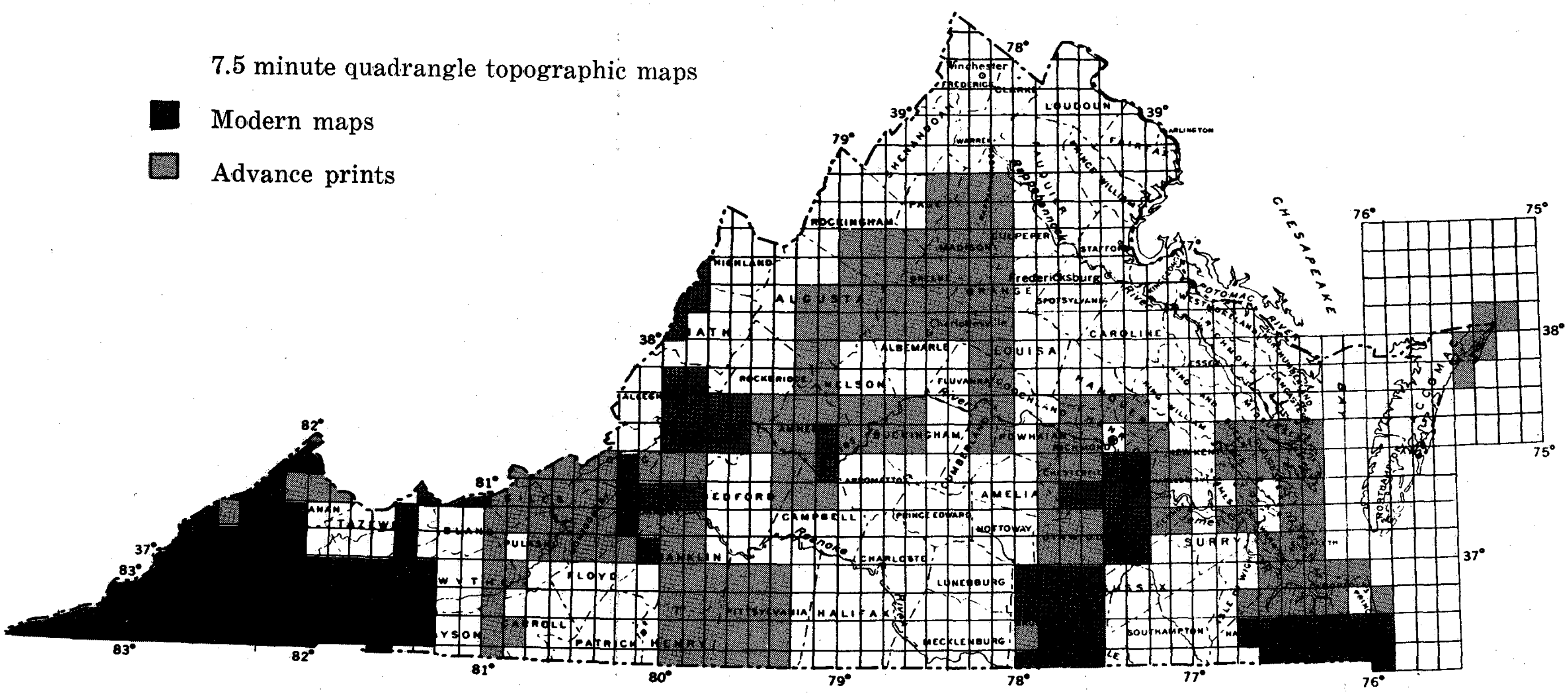


Shaded areas represent recent aerial-photograph coverage. Information concerning aerial photography may be obtained from the U. S. Geological Survey, Aerial Photography Section, G. S. A. Building, Washington 25, D. C.

TOPOGRAPHIC MAPS

7.5 minute quadrangle topographic maps

- Modern maps
- Advance prints



ADVANCE PRINTS

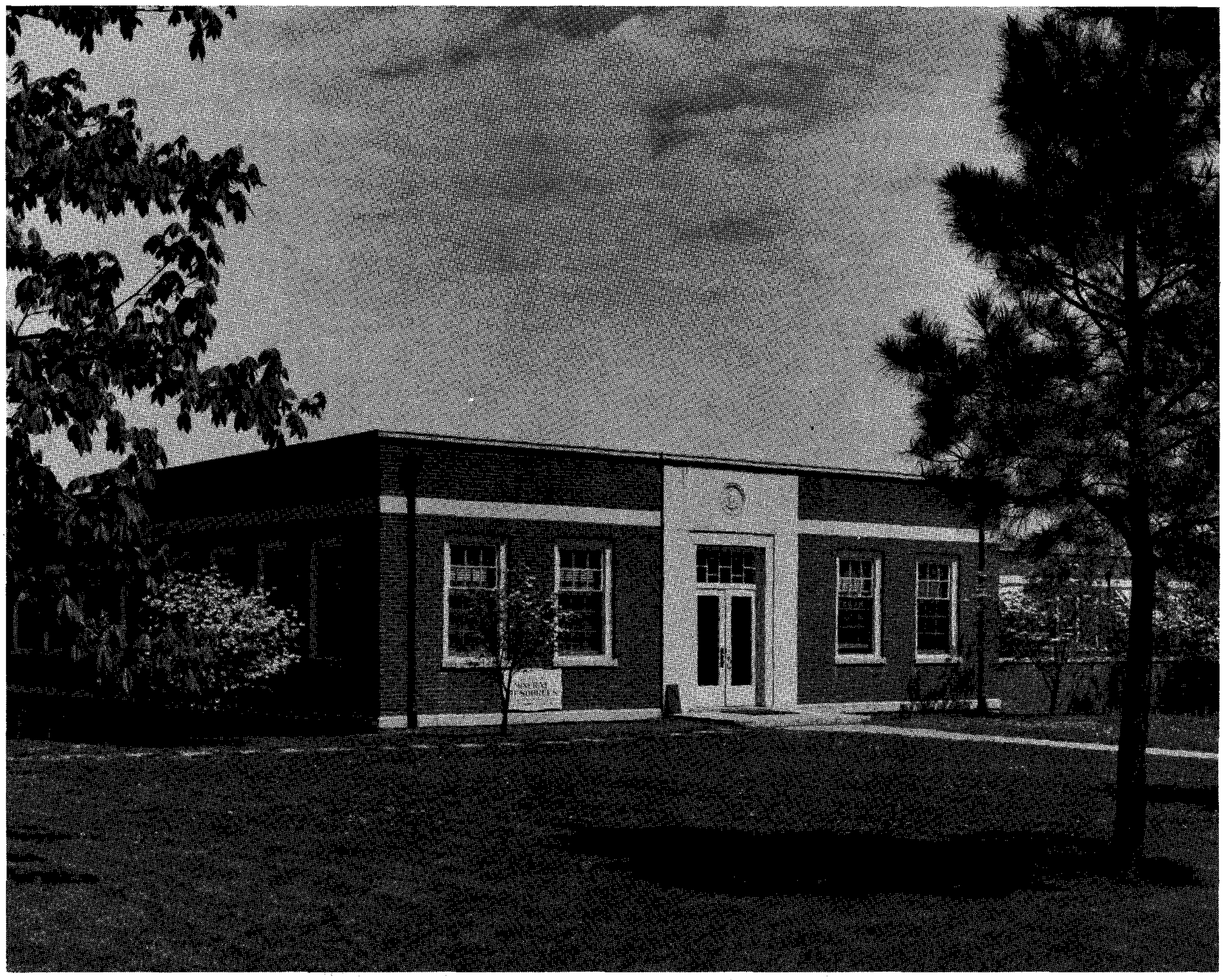
Advance prints (blue line) are available at 50 cents each from the U. S. Geological Survey, Topographic Division, 1109 N. Highland St., Arlington, Va.

PUBLISHED MAPS

State index is available free. Published maps are available at 30 cents each from the Virginia Division of Mineral Resources, Box 3667, University Station, Charlottesville, Va.

Division of Mineral Resources
Box 3667
Charlottesville, Virginia

Form 3547 Requested



Offices of the Virginia Division of Mineral Resources in the west wing of the Natural Resources Building, McCormick Road, Charlottesville, Virginia.